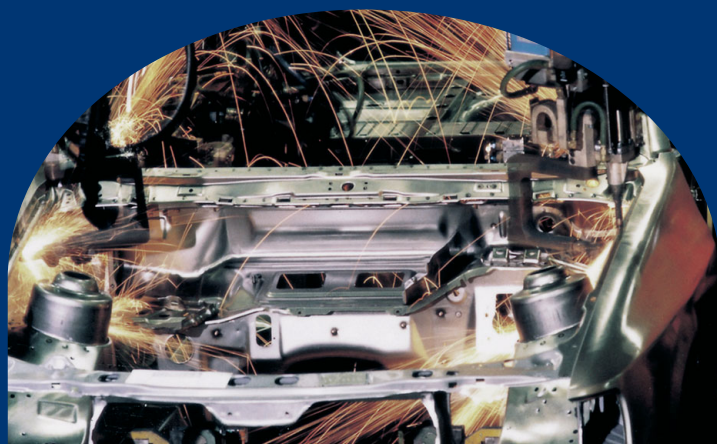# SWANTEC

The Simulation Software for Innovative Welding and Joining

SORPAS®

Ensure before welding™

Strategic partner for success

With more than 25 years of continuous research and development and nearly 20 years of devoted service to the industry, our innovative solution SORPAS® has been widely recognized and applied by industry leaders around the world.

Integrating Simulation Technology from Design to Welding Production

SORPAS®
Ensure before welding™

CAE · Simulation · Optimization · Planning

Towards Industry 4.0
for Digitalization of Welding
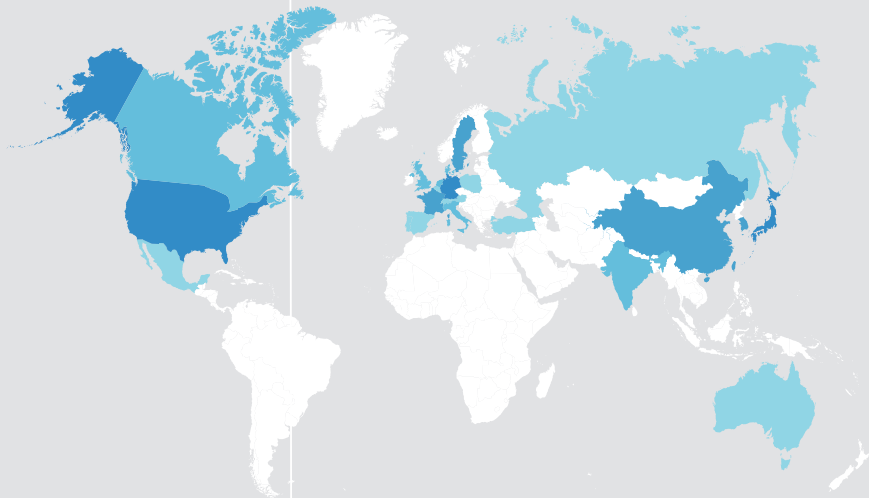
Customers, map designed by freepik

"We have been using SORPAS® since 2001 and have made many innovative developments in resistance welding, which have resulted in several patents. We are now further extending the application of simulation to process optimizations for supporting production planning".

– Mr. Matthias Graul, Volkswagen AG, Wolfsburg, Germany.

Volkswagen, the largest car maker in Europe, is the first commercial user of SORPAS® in automotive industry.

The SORPAS® concept

The key concept of SORPAS® is to combine welding engineering expertise with numerical simulation, and provide a customized software tool for engineers to use directly in industry for resistance welding and mechanical joining.
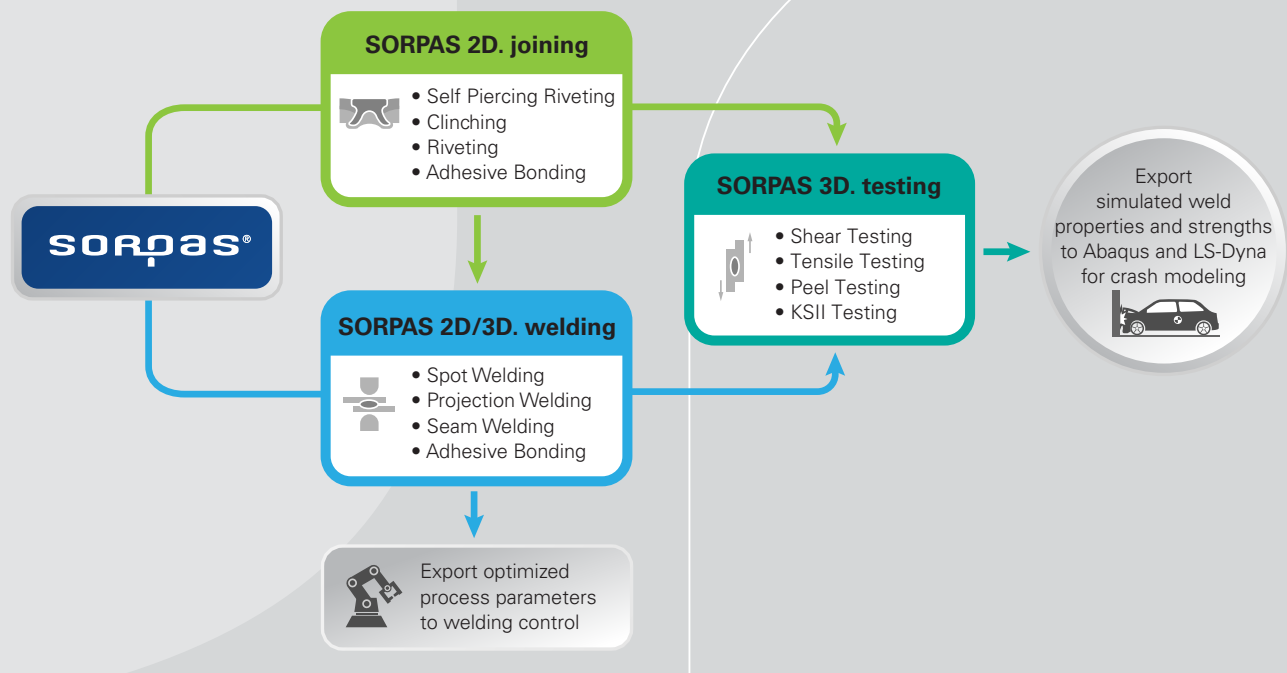
Save time

It is now possible to quickly simulate and optimize resistance welding and mechanical joining processes before undergoing physical tests to substantially speed up the development of new products and the solution of welding production problems, and also to speed up prototyping and optimizing production settings before launching new production lines.

Reduce cost

Saving time and money on development and reducing cost on production maintenance are the main benefits of using SORPAS®. SORPAS® can also help to minimize errors and maximize productivity by enhancing process optimizations.

Improve weld quality

SORPAS® can help to optimize the welding process thus increase production stability and reduce the common issues such as expulsions/splashes in production, thereby improve weld quality and productivity.

SORPAS 2D. joining
- Self Piercing Riveting
- Clinching
- Riveting
- Adhesive Bonding

SORPAS 3D. testing
- Shear Testing
- Tensile Testing
- Peel Testing
- KSII Testing

Export simulated weld properties and strengths to Abaqus and LS-Dyna for crash modeling

SORPAS 2D/3D. welding
- Spot Welding
- Projection Welding
- Seam Welding
- Adhesive Bonding

Export optimized process parameters to welding control

The competence of SORPAS®

- Spot welding
- Projection welding
- Seam welding
- Riveting, SPR and clinching
- Weld/joint strength testing

The industries needing SORPAS®

- Automotive industry
- Aerospace industry
- Electrical and electronics industry
- Rail carriage and rail track
- Machinery and metal processing

SORPAS® 2D.welding

With strong support of industrial leaders and professional partners, we will continue to dedicate ourselves to further develop and maintain SORPAS® being a reliable tool and promote technology advances in resistance welding.

The solutions of SORPAS®

- Welding process simulation
- Welding process optimization
- Intelligent weld planning
- Excel batch planning
- Production maintenance
- Weldability of materials
- Weld quality
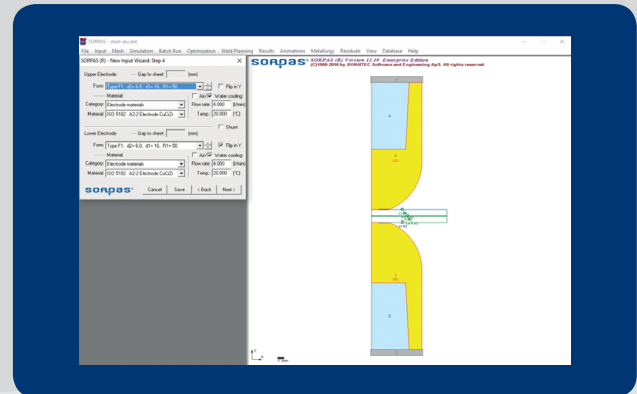
The input wizard helps easily to build up the weld combination of materials and prepare simulation data.
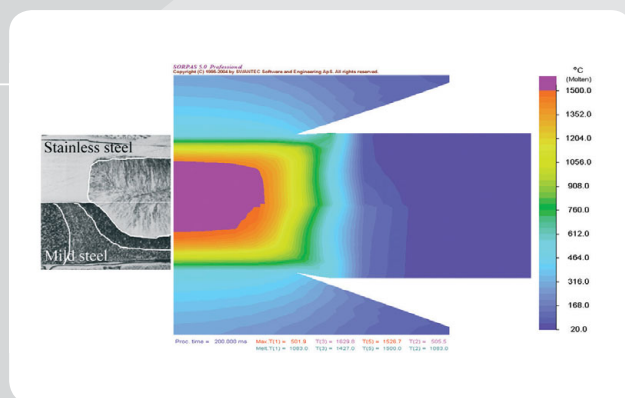
Simulation of spot welding 2.0 mm stainless steel to 2.0 mm mild steel sheets comparing to the cross section of real weld nugget.
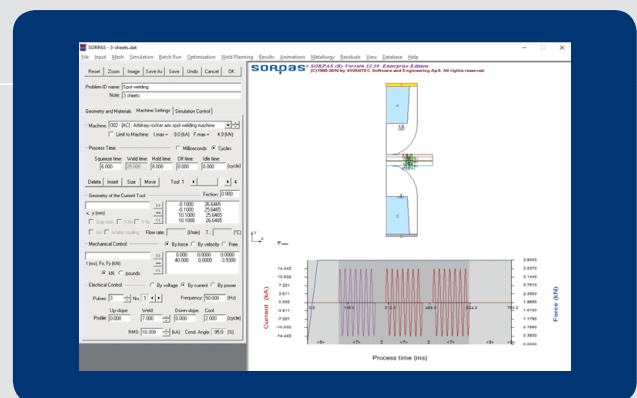
SORPAS® graphic user interface (GUI) for manually editing detailed data in the simulation model such as process parameters.

Input: Design parameters

- Geometry and dimensions
- Combination of materials
- Surface coatings and braze metals
- Material and machine databases

Input: Welding parameters

- Weld quality requirements
- Process parameter settings
- Welding machine characteristics
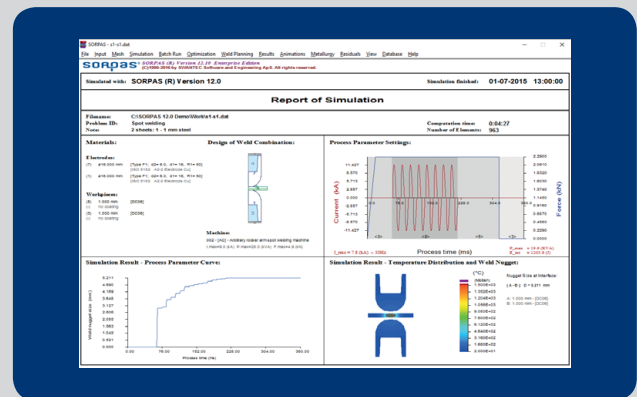- Water cooling of electrodes
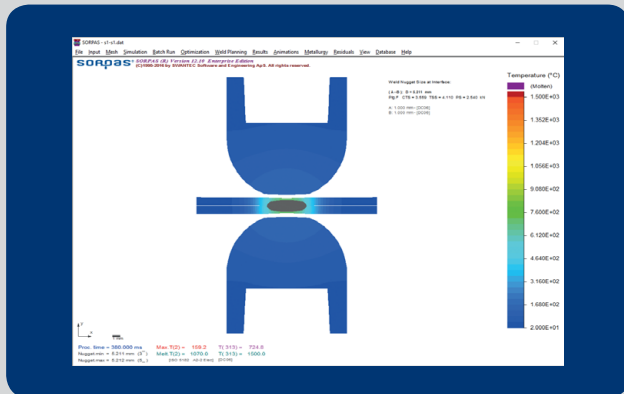
Final weld nugget formation showing the nugget size in each sheet and at each weld interface with indication of splash.
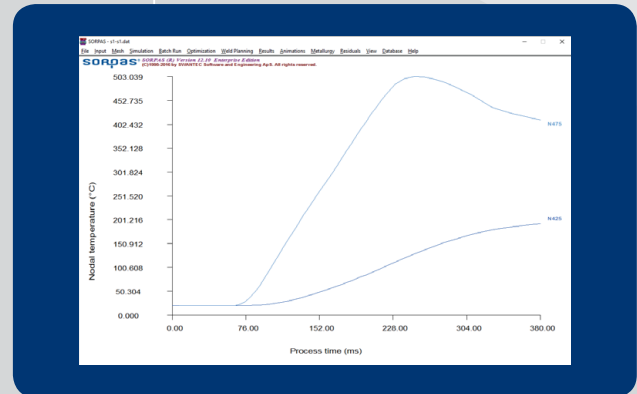
Output of simulated dynamic temperature history curves at two selected nodal points.
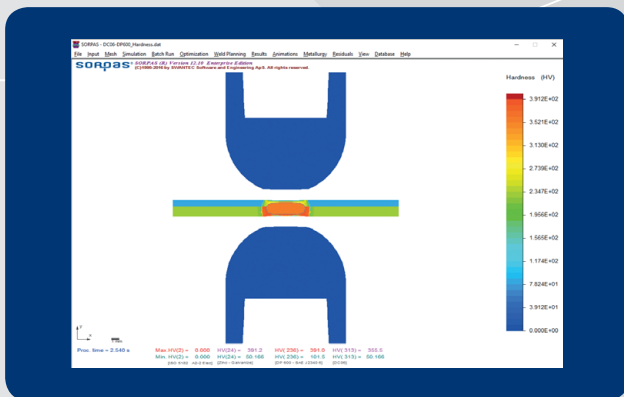
Hardness distribution after welding

Report of simulation showing both the input conditions and the main results of simulation.

Output: Dynamic parameter curves

- Weld nugget size evolution
- Local temperature development
- Dynamic resistance curves
- Displacement of electrode
- Etc.

Output: Weld quality results

- Weld nugget sizes
- Microstructures and hardness distribution
- Weld strengths and failure modes
- Residual stresses and cracking risks
- Etc.

SORPAS® 2D.welding Solutions

SORPAS® is widely used for simulation and optimization of resistance welding processes. The new function of Excel Batch Planning can be used to predict weld schedules for many weld tasks at a production plant.
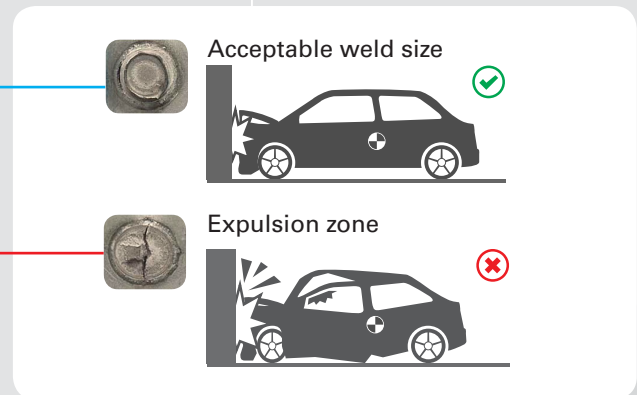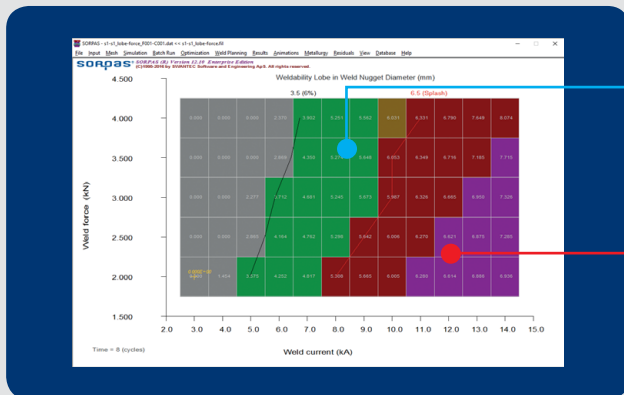
Optimization - for the best weld quality
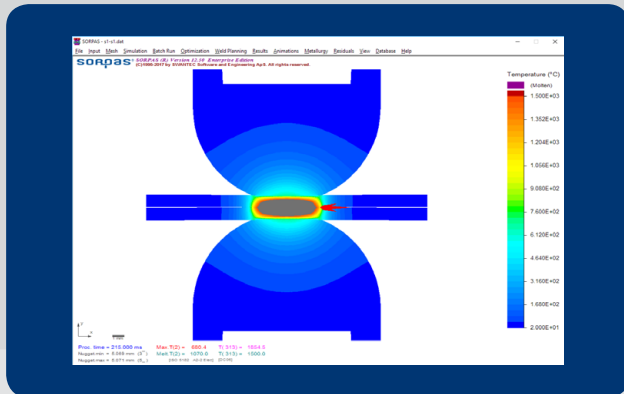
Splash (expulsion) is predicted as the limit of the welding range or process window for welding process optimizations.
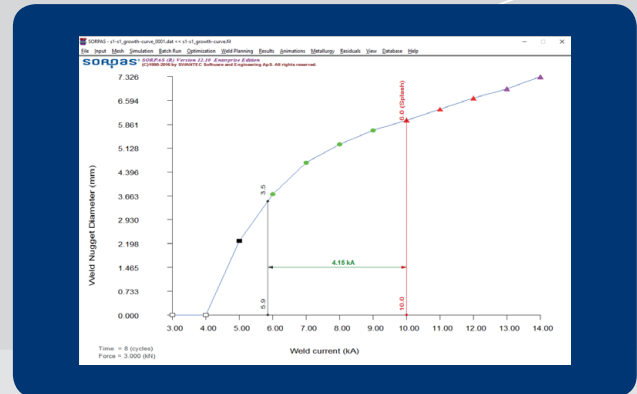
Weld growth curve is simulated for prediction of process window with indication of the optimal weld current range and splash limit.

Finding the welding process window with good parameters by weld planning and optimization is the key to ensure before welding whereby to enhance the process control and production maintenance for achieving the best weld quality.
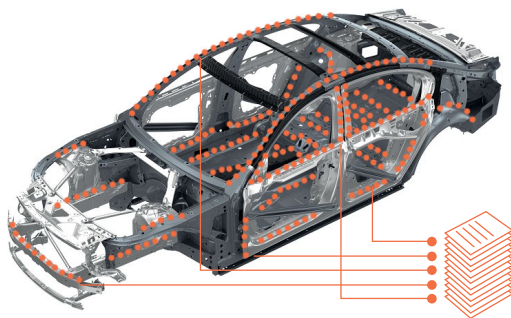
Simulation modes

- Process simulation
- Weld growth curve
- Weldability lobe
- Weld planning

Benefits

- Speed up launching of new production
- Improve weld quality
- Increase production stability
- Reduce expulsion/splash

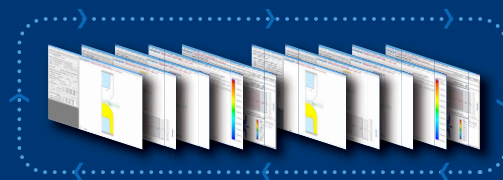# Planning - for the best welding production

Step 1: Collect weld tasks into Excel file

Around 4000-6000 welds with 300-500 new sheet combinations need to be tested and optimized for launching a new car production.

### Step 2: Run Excel batch planning

SORPAS® makes simulation files automatically by directly reading data from the Excel file and runs all simulations and optimizations.

Step 3: Output weld schedules to Excel file

The optimized welding parameters and process ranges are predicted by SORPAS® and output back into the same Excel file.

Provide start parameters to welding control
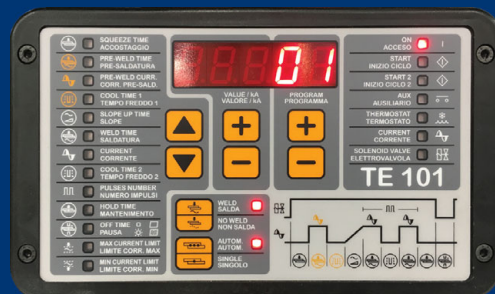
Transfer the optimized parameters to welding controllers.

Intelligent weld planning

• Predict weld process windows
• Optimize process parameter settings
• Weld growth curves and weldability lobes
• Determine welding and cooling procedures
• Troubleshoot welding problems

Benefits

• Classify weldability of the weld tasks
• Maximize productivity with massive simulations
• Reduce time for production launching
• Improve weld quality
• Reduce costs of production maintenance

SORPAS® 2D.welding Applications

Resistance welding is one of the most productive and reliable assembly processes. It is widely applied in manufacturing industry such as automotive, aerospace, railway, and electrical and electronics industry.
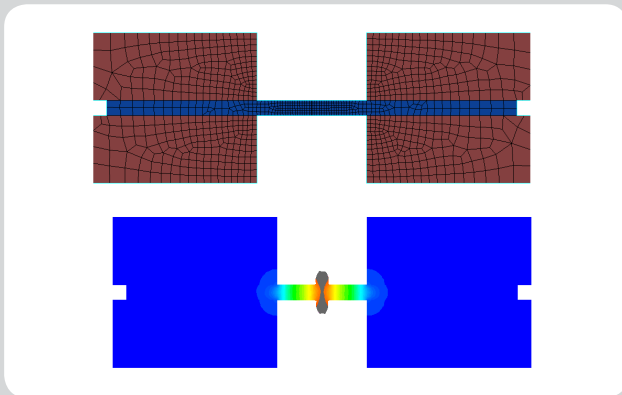
Industrial applications
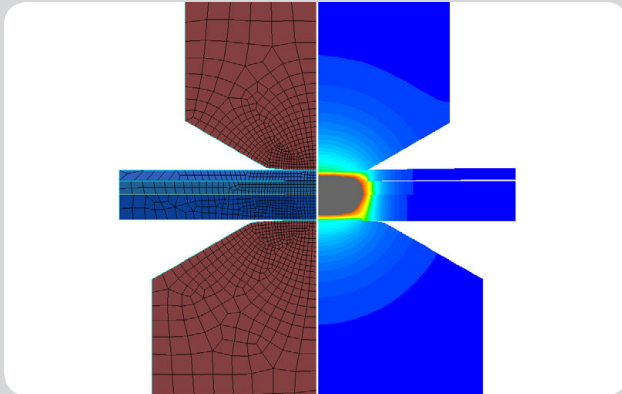
Spot welding
Three-sheet joint of low carbon steel, high strength low alloy (HSLA) steel, and Dual Phase (DP) steel sheets.
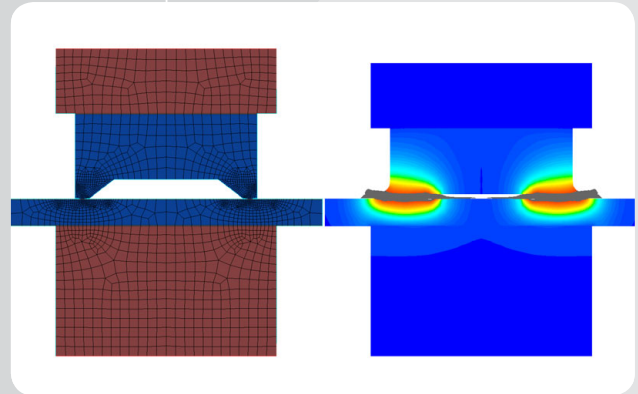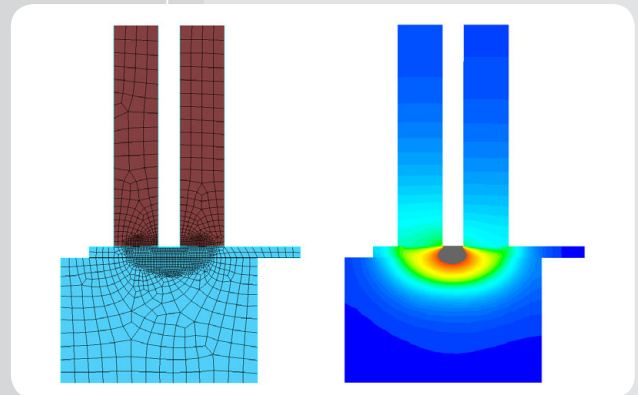

Projection welding
Square nut with corner projections joined to steel sheet showing the weld after collapse of the projections.

Resistance butt welding
Two steel plates joined at the ends with resistance heating and subsequent forging during the butt welding.

Micro resistance welding
Parallel gap welding for joining thin foil to substrate plate of titanium alloys.

Applications

- Evaluate weldability of materials
- Evaluate design of weld combinations
- Evaluate design of electrodes
- Optimize welding processes

Who would use SORPAS®

- R&D and CAE engineers
- Welding process planners
- Production maintenance engineers
- Welding engineers at repair shops

SORPAS® 2D.joining

Mechanical joining is especially applied for joining aluminum alloys and dissimilar materials in automotive and aerospace industries. SORPAS® is now further developed for simulation of mechanical joining process.
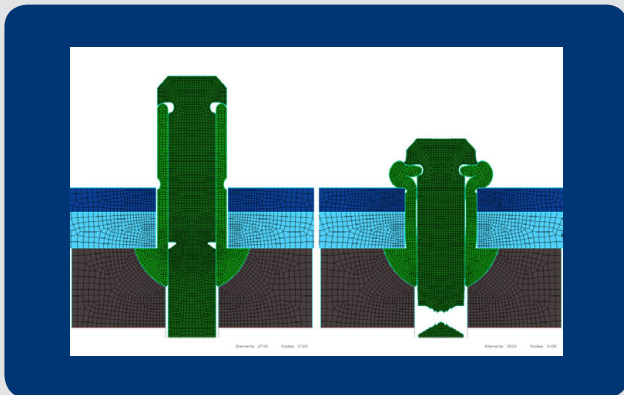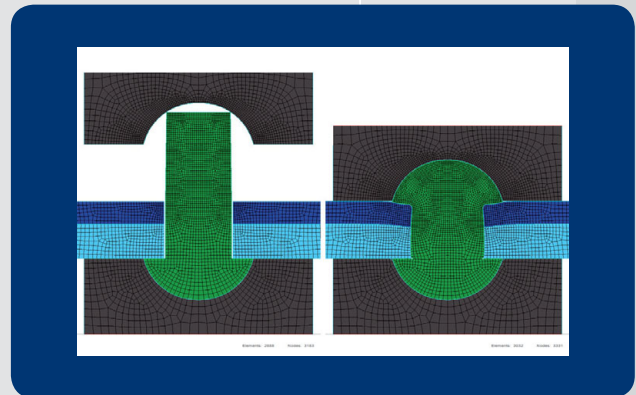
Better Simulation of Joining by Forming
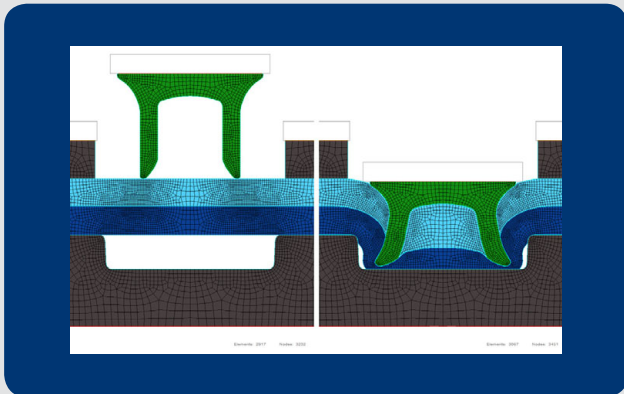
Simulation of self piercing riveting (SPR) with adaptive remeshing and fracture of one sheet during piercing.
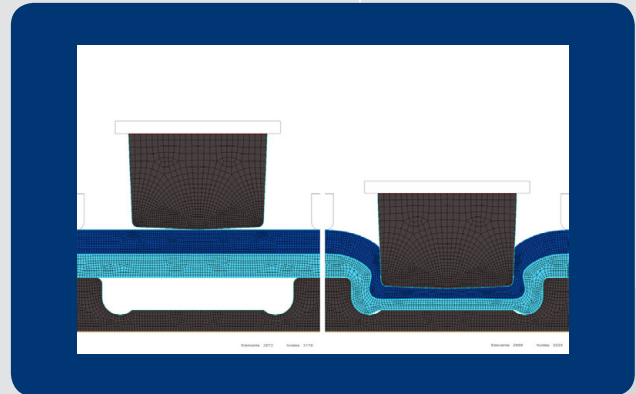
Simulation of clinching with adaptive remeshing.

Simulation of blind riveting with adaptive remeshing and fracture of the mandrel.

Simulation of solid riveting with adaptive remeshing.

Functions

• Adaptive remeshing
• Fracture and cracking
• Contact modeling
• Friction at contacts
• Surface coatings

Applications

• Riveting
• Self-piercing riveting (SPR)
• Clinching
• Blind riveting
• Joining with adhesive

SORPAS® 3D.welding

The development of SORPAS® 3D has continued on the same concept of SORPAS® 2D with easy-to-use graphic user interface (GUI) and straightforward functions for complex and challenging applications of resistance welding.
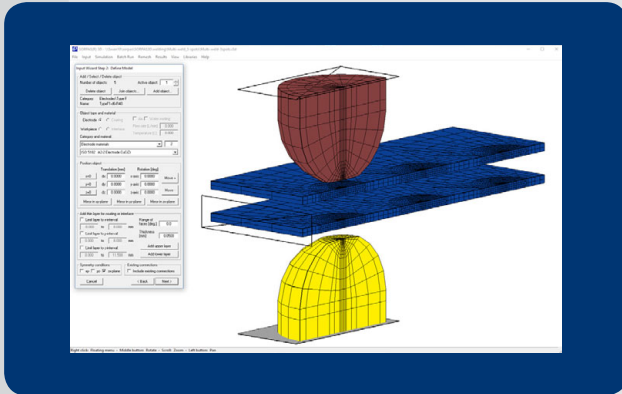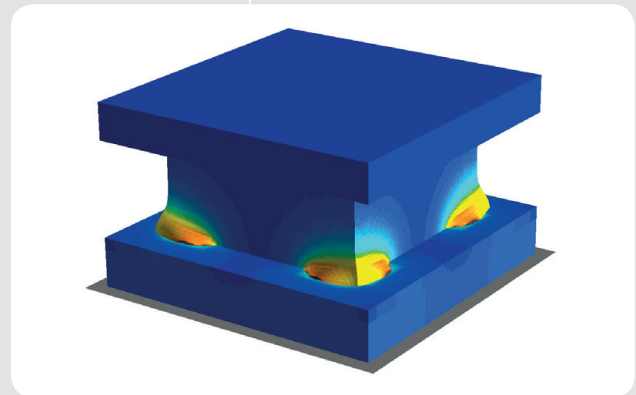

The Input Wizard helps easily to build 3D model and to specify welding process for complex welding applications.
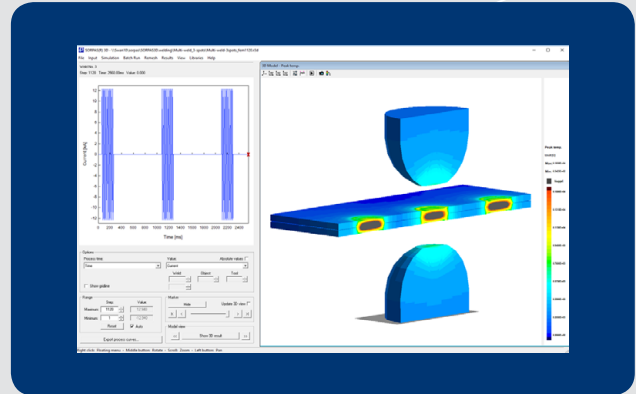
3D simulation of a sequence of multiple spot welding with 3 welds to study the shunt effect.
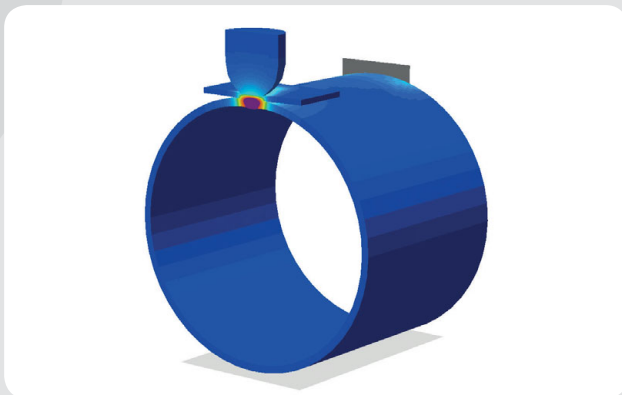
3D simulation of one-sided spot welding of sheet to tube.

3D simulation of square nut welding.

Input

• Build 3D mesh model
• Set up tool connections
• Specify welding program
• Program movement

Output

• Process parameter curves (current, nugget size, etc.)
• Distribution of field variables (temperature, stress, etc.)
• Animated welding process simulation
• Micro structures and hardness

SORPAS® 3D.testing

After welding process simulation, it is now possible to continue with simulation of the weld strength tests based on the simulated weld result and new hardness distribution. It can be done with all-in-one simulation model.
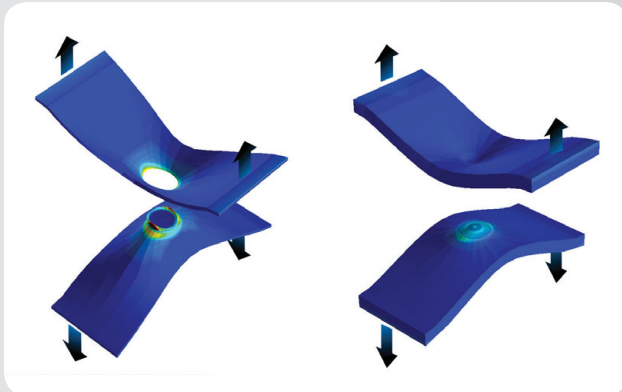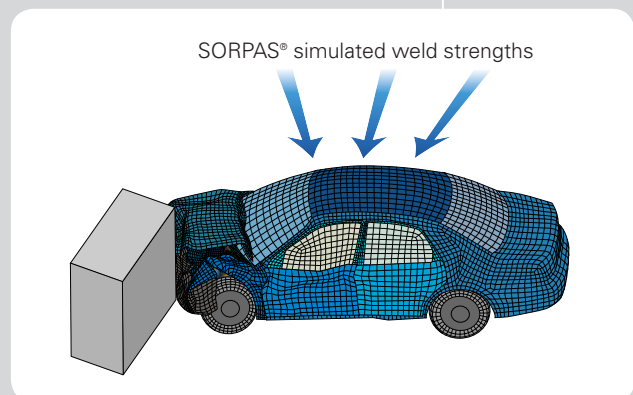

Cross tension test of thin sheet spot weld with plug failure and cross tension test of thick sheet spot weld with interface failure.
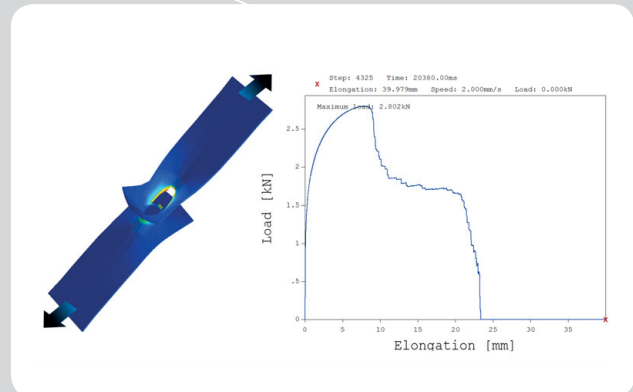
Tensile shear test of spot weld and load-elongation curve.
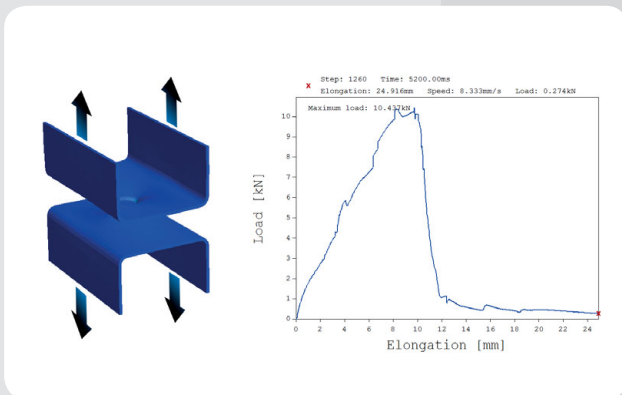
Axial tension test of spot weld and load-elongation curve.

SORPAS® simulated weld strengths

Export weld properties and strengths to other software, e.g. Abaqus and LS-Dyna, for further structural simulation or crash modeling.

Input

- Simulated weld results or pre-made weld
- Connection or clamping of test tools
- Test tool moving velocity
- Test total elongation

Applications

- Predict the weld strengths
- Predict failure modes (plug or interface)
- Output the load-elongation curves
- Export weld strengths to other software

SWANTEC

History

1988 – Engineering research
Research in resistance welding started at the Technical University of Denmark with many PhD and MSc projects and national research projects.

1994 – Computer simulation
Development of numerical models and programming started with a large research program in close collaboration with leading companies in Denmark.

1999 – Establishment of company
SWANTEC started as spin-off private company for marketing and further developing SORPAS® that is now used by companies and institutes worldwide.

Business areas

Welding & joining simulation software – SORPAS®
• Development
• Technical support
• Industrial service

Engineering service
• European and national projects
• Projects for large companies
• Consulting for small companies

Technology transfer
• International seminars
• Training and workshops
• Scientific publications

SWANTEC is always in the front line of technology with unique competence in both engineering expertise and an innovative approach in welding and joining.

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